



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/902,727	07/12/2001	Arpan P. Mahorowala	.YOR92000064US1	9512

7590 09/23/2003

Burton A. Amernick
Connolly Bove Lodge & Hutz
P.O. Box 19088
Washington, DC 20036-3425

EXAMINER

NOVACEK, CHRISTY L

ART UNIT	PAPER NUMBER
----------	--------------

2822

DATE MAILED: 09/23/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/902,727

Applicant(s)

MAHOROWALA ET AL.

Examiner

Christy L. Novacek

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 June 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-31 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-31 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

This Office Action is in response to the amendment filed June 30, 2003.

Response to Amendment

The amendment to the specification is sufficient to overcome the objections to the specification stated in the previous Office Action. Therefore, these objections have been withdrawn.

The amendment of claims 1, 5, 9-11 and 17 are sufficient to overcome the objections to these claims stated in the previous Office Action. Therefore, these objections are withdrawn.

The amendment of the claims and specification are sufficient to overcome the rejections of claims 6, 7, 11, 14, 15, 17-19 and 21 under 35 U.S.C. 112, first paragraph stated in the previous Office Action. Therefore, these rejections are withdrawn.

The amendment of claims 27 and 30 is sufficient to overcome the rejection of claims 27 and 30 under 35 U.S.C. 112, second paragraph stated in the previous Office Action. Therefore, these rejections are withdrawn.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-26 and 31 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1, 3, 7 and 19 recite the limitation of “wherein said underlayer is a tuned polymer”. The term “tuned polymer” has not been disclosed in the specification with adequate clarity and precision to enable one of ordinary skill in the art to determine the metes and bounds of this limitation. As is stated in the MPEP, “If the language of the claim is such that a person of ordinary skill in the art could not interpret the metes and bounds of the claim so as to understand how to avoid infringement, a rejection of the claim under 35 U.S.C. 112, second paragraph would be appropriate.” This rejection is discussed further in the *Response to Arguments* section below. Claims 2-26 and 31 are rejected for being dependent upon claim 1.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1-8, 12, 13, 17, 18, 20 and 22-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pike et al. (US 6,420,097) in view of the admitted prior art.

Regarding claims 1, 3, 20 and 30, Pike discloses producing a lithographically printed image having a reduced critical dimension. This method involves providing a semiconductor substrate (114), providing a tuned polymer underlayer (126) on the substrate wherein the underlayer is free of any element that forms a non-volatile oxide (comprises a BARC of a water soluble fluoropolymer), and providing a photoresist (PR) layer (122) on the underlayer (Fig. 4a-4d; col. 3, ln. 61-col. 4, ln. 42). The PR is exposed to radiation to form an image therein. This image is transferred into the underlayer. A controlled overetch of the underlayer is performed in order to laterally thin the underlayer. The PR layer is formed such that it comprises a material that is etch-resistant in the step of etching the underlayer. Specifically, Pike states that

Art Unit: 2822

the PR may be silylated (silicon added thereto) in order to improve its etch selectivity to the underlayer (col. 4, ln. 47-48). Pike discloses that an anisotropic etch may be used to etch the underlayer but does not describe a particular type of etching that is to be used (col. 5, ln. 1-3). The admitted prior art states that a reactive ion etch (an anisotropic etching process) using oxygen plasma is "well known in the art" (pg. 9, ln. 8-9). At the time of the invention, it would have been obvious to one of ordinary skill in the art to etch the underlayer using an oxygen reactive ion etching process because Pike discloses using an anisotropic process and, in the absence of the disclosure of any particular process, one of ordinary skill in the art would look to use a conventional process such as the oxygen reactive ion etching process disclosed in the admitted prior art.

Regarding claims 2 and 4, Pike discloses that the underlayer may be made of a fluoropolymer (no silicon, boron, phosphorus, germanium or aluminum) (col. 4, ln. 8-11).

Regarding claims 5 and 17, as stated above in reference to claim 1, Pike discloses that the PR may be silylated (silicon added thereto) to improve its etch selectivity to the underlayer (col. 4, ln. 46-48).

Regarding claims 6 and 18, as stated above in reference to claim 1, the admitted prior art discloses that an oxygen reactive ion etching process is conventional in the art.

Regarding claim 7, Pike discloses that the tuned polymer may be AR19, produced by Shipley Corporation, which contains carbon, hydrogen and oxygen.

Regarding claim 8, Pike discloses that the underlayer may comprise an antireflective coating (BARC) (col. 4, ln. 7-11).

Regarding claims 12 and 13, Pike discloses that the radiation used to image the PR layer can be 248-193 nm ultraviolet radiation (UV) (col. 1, ln. 20-28; col. 4, ln. 16-18).

Regarding claims 22-26, Pike discloses overetching the underlayer such that it becomes approximately the width of the desired gate or structure linewidth (col. 4, ln. 23-27). However, Pike does not disclose how the overetching is controlled. The admitted prior art discloses that it is well known in the art to control the etch process by using dilution of the oxygen plasma with non-reactive gases such as nitrogen, and also by controlling various process parameters which include RF power, operating pressure, gas flowrate, backside He pressure and electrode and wall temperatures (col. 9, ln. 21-26). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the methods disclosed by the admitted prior art to control the etch rate of Pike's etching process because Pike discloses controlling the etch process but does not disclose a specific method of doing so, and the admitted prior art discloses that controlling various process parameters is conventional in the art.

Regarding claim 27, Pike discloses a semiconductor substrate, an organic layer (BARC of fluoropolymer) provided on the substrate, and a photoresist layer provided on the organic layer, wherein the photoresist layer has a first image developed therein, and wherein the organic layer has a second image, of reduced critical dimension and congruent with the first image, developed therein.

Regarding claims 28 and 29, Pike discloses providing a substrate, forming a reduced critical dimension bilayer resist image on the substrate, transferring the image into the substrate forming a circuit image, and forming circuit element materials in said circuit image. Pike discloses that the circuit image may be a gate conductive layer or device layer (col. 3, ln. 64-65; col. 4, ln. 23-29).

Response to Arguments

Art Unit: 2822

Applicant's arguments filed June 30, 2003 have been fully considered but they are not persuasive.

Regarding the rejection of claims 3, 7 and 19 under 35 U.S.C. 112, second paragraph for their use of the limitation of "tuned polymer", Applicant has argued that the "characteristics and properties defining and required of a tuned polymer were disclosed at page 7, line 17 through page 18, line 11." The section of the specification referred to by Applicant states in part, "The optical properties *should* include a refractive index (n) at the imaging wavelength of from about 1.7 to about 1.9. The optical properties *should* include an extinction coefficient (k) of from about 0.20 to 0.22 at the imaging wavelength of 248 nm. The optical properties of tuned polymer 6 *should* be relatively stable under a variety of processing conditions. It is *desirable* that the physical properties of the tuned polymer 6 include an optimized interaction between the polymer layer and top, imaging layer 7. Polymer layer 6 *should* be strongly adherent to imaging layer 7, but polymer layer 6 *should* not intermix with imaging layer 7." Contrary to Applicant's assertion, this language in the specification does not recite the characteristics and properties "defining and required" of a tuned polymer, but merely states some of the properties that it should (may) have. From Applicant's specification it cannot be determined if the "tuned polymer" is required to have all of the properties that the specification states that it "should" have or just one of these properties or if it could have other properties so long as the properties are optimized according to the device being manufactured.

Regarding the rejections of claims 1, 2, 4-6, 8, 12, 13, 17, 18, 20 and 22-30 under 35 U.S.C. 103(a) as being unpatentable over Pike et al. (US 6,420,097) in view of the admitted prior art, Applicant argues that Pike does not disclose a "bilayer resist". Applicant's "bilayer resist" is made of a lower layer of an antireflective coating (ARC) and a top layer of photoresist material.

Art Unit: 2822

Pike also discloses an etching mask made of a lower layer of ARC and a top layer of photoresist material. Therefore, so far as Applicant's have defined a "bilayer resist", Pike meets this limitation.

Regarding the rejections of claims 1, 2, 4-6, 8, 12, 13, 17, 18, 20 and 22-30 under 35 U.S.C. 103(a) as being unpatentable over Pike et al. (US 6,420,097) in view of the admitted prior art, Applicant argues that Pike does not disclose a "tuned polymer". Applicant then goes on to say, "The properties of a tuned polymer include [sic] an optimized interaction between the polymer layer and the imaging resist layer." Pike discloses that the anti-reflective coating "is typically a water soluble fluoropolymer" (col. 4, ln. 8-9) and, "variations to the hardmask layer could include (1) an organic or inorganic material may be used which minimizes reflection of the incident radiation during patterning of the resist layer, such as a bottom anti-reflective coating (BARC), (2) a composite (multi-layer) material may be used to absorb the incident radiation, or (3) a multi-layer material may be used consisting of a top anti-reflective layer such as a nitride film and a bottom etchstop layer such as an oxide film." Therefore, Pike discloses using a hardmask that is a polymer and is optimized for the particular device being manufactured, thus it is a "tuned polymer".

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO**

Art Unit: 2822

MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christy L. Novacek whose telephone number is (703) 308-5840. The examiner can normally be reached on Monday-Thursday and alternate Fridays 7:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (703) 308-4905. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

CLN
September 17, 2003



AMIR ZARABIAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800